ASC Research Topics of Relevance to Biodefense Programs

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Algorithmic advancements are needed to support pathogen assay development

- Improved theoretical understanding/prediction of DNA hybridization

- Improved prediction of multiplexing of existing DNA diagnostics

- *De novo* computational development of optimally multiplexed DNA diagnostics

- Improved algorithms for alignment of all available genomic sequence data

    - Full genome sequence

    - Draft genome sequence

    - Fragments of sequence (gene regions, ESTs, etc.)

- Improved algorithms for *global* whole genome similarity comparisons

    - Identify pathway components, common regulatory mechanisms, etc.

- Improved structural homology comparison resources

- Computational simulation of global genomic mutational dynamics in bacteria and viruses

Research advancements are needed to support information fusion efforts

• **Extraction of relationships from free text based on a given ontology**

• **Modeling various computing architecture models to determine the optimal way to support very large graphs**

• **Hybrid query optimization across a graph and relational model of the same data**

• **Ontology-driven tools to simplify data source ingest**

• **Data provenance tracking**

• **Querying multi-modal data**

• **Usable interfaces to pose complex questions and understand the results**

Summary

- **We are pushing the envelope on diagnostic assay development and information fusion.**

- **Both areas are in great need of advanced algorithm support.**

- **It is often difficult to explain to programmatic managers why research is needed to accomplish what they may see as "easy" extensions of existing capabilities (e.g., scaling issues).**

- **An OUO environment is needed to be able to effectively discuss our algorithm needs in sufficient detail.**

- **More details will be provided in upcoming talks: Critchlow, Samatova, Chow, etc.**